MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for November, 1898, is based on about 2,762 reports from stations occupied by regular and voluntary observers, classified as follows: 162 from Weather Bureau stations; numerous special river stations; 32 from post surgeons, received through the Surgeon General, United States Army; 2,385 from voluntary observers; 96 received through the Southern Pacific Railway Company; 29 from Life-Saving stations, received through the Superintendent United States Life-Saving Service; 31 from Canadian stations; 10 from Mexican stations; 7 from Jamaica, W. I. International simultaneous observations are received from a few stations and used, together with trustworthy newspaper extracts and special reports.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Meteorologist to the Hawaiian Government Survey, Honolulu; Dr. Mariano Bárcena, Director of the Central Meteorological and Magnetic Observatory of Mexico; Mr. Maxwell Hall, Government Meteorologist, Kingston, Jamaica; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; and Commander J. E. Craig, Hydrographer, United States Navy.

The REVIEW is prepared under the general editorial supervision of Prof. Cleveland Abbe.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to generally conform to the modern international system of standard meridians, one hour apart, beginning with Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local meridian is mentioned.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

One of the most disastrous storms of recent years visited the Middle Atlantic and New England States November 26–27, 1898. At least 200 lives were lost, and fully 100 vessels wrecked along the New England coast, and railway traffic was blocked by snow. A description of this storm, together with charts which present the general weather conditions over the eastern half of the United States at 8 a. m., noon, and 3 and 8 p. m. of November 26, and 8 a. m. and 8 p. m. November 27, appears in this issue of the REVIEW. (See charts X, XI, and XII.) The action of the Weather Bureau in warning maritime and other interests of the approach of the storm is also indicated.

The Lake region and middle and north Atlantic coasts were visited by several storms of unusual severity. The first of these crossed from the upper Lakes to the St. Lawrence Valley during the 1st and 2d. From the 4th to the 6th a storm moved from the British Northwest Territory to the St. Lawrence Valley, attended by very strong south to west gales over Lakes Michigan, Erie, and Ontario. The highest velocity of the month at Chicago, 76 miles from the south, on the 7th, attended the passage of a storm center from Lake Superior to the St. Lawrence Valley during the 7th and 8th. On the 9th and 10th a disturbance advanced from Texas to western New York, and thence to Nova Scotia by the morning of the 11th, causing northeast to northwest gales of 50 to 60 miles an hour over southern Lake Michigan, and correspondingly high velocities from the north and northwest on the lower Lakes and along the New York and south New England coasts. On the 18th a storm appeared over Manitoba and passed thence to the New Jersey coast by the morning of the 19th, and during the 19th and 20th caused wind velocities, mostly from west to northwest, of 50 to 60 miles an hour from Hatteras to New York.

From the 18th to the 23d a storm crossed the continent from the north Pacific coast to Nova Scotia, and on the 21st and 22d caused gales of over 50 miles an hour in the Lake region. The passage of this storm was followed by the principal cold wave of the month, which carried the line of freezing temperature to the middle Gulf and south Atlantic coasts. In no instance did sections visited by these storms fail to receive early and ample warning of their approach.

THE NORTH ATLANTIC COAST STORM OF NOVEMBER 26-27, 1898.

The records of the Weather Bureau show that disturbances of the class to which this storm belongs have caused some of the severest northeast gales and the heaviest falls of snow experienced in New York and New England. A well-remem-

bered storm of this general class occurred in March, 1888, when the force of the wind along the middle Atlantic and New England coasts was almost unprecedented, and a snow blockade continued several days over a great portion of New York and New England.

A distinctive feature of these storms is found in the fact that a development of destructive strength begins with a union at some point off the middle Atlantic or south New England coasts of two storms, one from the west or northwest, and the other from the south Atlantic coast.

In the case of the storm now under consideration the charts X, XI, and XII show that on the morning of November 26 a storm center occupied lower Michigan, and an area of high barometer covered New England. A closer scrutiny of the reports will show evidence of a cyclonic wind circulation along the south Atlantic coast. At noon of the 26th, four hours later, the Michigan storm center had advanced to Pittsburg, Pa., and the southern storm had deepened rapidly and moved to a position off Hatteras, N. C. By 3 p. m. the centers had united off Norfolk, Va., and by the 8 p. m. report the center of disturbance had deepened and was located off the New Jersey coast. The path of the storm center during the next twelve hours is traced to a point near Cape Cod, where the barometer read 29.30 inches, or slightly below, and the greatest storm intensity was shown. Passing northeastward the center of disturbance reached Nova Scotia the night of the 27th.

That these movements and the subsequent severe development of the storm were anticipated is shown by the following storm-signal orders and special snow warnings which were telegraphed to maritime, commercial, and traffic interests throughout New York and New England at 10:30 a. m. of the 26th, when the weather conditions in those regions were serene.

Northeast storm signals were ordered along the New England coast from Newport to Eastport, with the following advisory message:

Storm central near Detroit moving east. East to northeast gales with heavy snow to-night. Wind will shift to west and northwest with much colder Sunday.

Southeast storm signals were ordered at Sandy Hook, New York, New Haven, and Montauk Point, with the following message:

Storm central near Detroit moving east. Wind will increase to south and southeast gales this afternoon and shift to west to-night, with snow. Decidedly colder Sunday.

Storm signals were also displayed along the Atlantic coast as far south as Norfolk, with additional warning of snow or rain, and the storm warnings for the lower Lakes included a warning of snow and a cold wave. The Bureau of Navigation, Navy Department, and the maritime exchanges at New York and Philadelphia were informed of the action taken in notifying marine interests of the impending severe storm of wind and snow.

In addition to the above advices the following special warning was telegraphed to all Weather Bureau offices in New York and New England for distribution throughout their respective districts:

Heavy snow indicated for New York and New England to-night. Notify railroad and transportation interests.

At the same hour the Pennsylvania and the Baltimore and Ohio railroad companies were notified:

A cold wave with heavy snow will prevail to-night in the Allegheny Mountain districts.

During the night of the 26th the storm increased rapidly in violence and reached its height during the morning of the 27th, when the maximum wind velocities ranged from 50 to 60 miles an hour from New York to Eastport, with an extreme velocity of 64 miles an hour at New York. Heavy snow Saturday night was followed during Sunday by clearing weather in the interior of New York and New England, and by the evening of the 27th the winds had begun to diminish from the northwest in the coast regions.

It will be observed from the foregoing that all action in connection with wind and snow warnings was based upon the morning reports of November 26, and that while later and special noon and 3 p. m. reports confirmed the action taken they did not call for an extension or modification of the morning advices.

The rapid advance of the western storm center to the Atlantic coast was foreseen, and the presence of an area of high barometer and low temperature over New England favored not only the south-of-east course of the storm, but also its subsequent severe development. The presence of a storm off the south Atlantic coast was indicated, rather than shown, by the morning reports, and the northward movement of this storm during the day of the 27th to a union with the western storm was an occurrence for which due allowance had been made.

The following extracts from reports made by observers of the Weather Bureau show the general character of the storm at points along the middle Atlantic and New England coasts:

Portland, Me., E. P. Jones, observer:

November 26.—Fresh to gentle westerly backing to fresh and brisk northeasterly winds.

27.—High northeast to northwest winds, with light and heavy snow. High winds and heavy snow caused great damage to shipping. From Cape Cod to Eastport reports at hand show that 56 vessels were totally wrecked, while 49 were ashore with hardly a chance of being saved. Of the 56 wrecks, barges not included, 43 craft aggregated 12,202 gross tons; of those in perilous positions, 28 aggregate 7,159 tons. The stranding of the big English liner *Ohio* and the ocean tug *Tamaqua* is not included in the estimate, nor are the big coal barges ashore in Boston Harbor. It is thought that 400 lives were lost along the New England coast during this storm. Special information to the captain of the steamer *Bay State* caused him to remain at his wharf. He was warned not to go out.

Boston, Mass., J. W. Smith, observer:

November 26.—Clear morning, but weather clouded up as the day advanced, and snow began to fall at 7:37 p. m., becoming heavy after 9:30 p. m. Light west winds until noon, then shifted to easterly, and northeast at 2:45 p. m., slowly increasing in force during the afternoon and evening. Northeast storm-signal order received at 11 a. m., with warning of heavy snowfall, the warnings of the approaching storm and heavy snow being distributed by all available means. Much inquiry for information from transportation, shipping, railroad, and other interests.

27.—The storm increased greatly in severity during the night, becoming one of the most severe for years. From 3 a. m. to 1 p. m. the hourly wind velocity ranged from 40 to 50 miles, with a maximum velocity of 60 miles at 11 a. m. and an extreme velocity at the rate of 72 miles an hour for 1 mile at 11:02 a. m. During the afternoon the wind diminished in force from the north and shifted to northwest. Snow fell heavily during the night to a depth of about 9 inches, and drifted heavily, completely stopping all railroad service, both steam and electric. The snow continued during the day and into the night, and at 8 p. m. 12 inches had fallen.

The storm caused great damage along the coast in this vicinity. Many vessels were wrecked and summer cottages blown down. In Boston harbor more than 30 vessels were reported wrecked or blown ashore, including schooners, barges, and one steamship. Six seamen were reported drowned in the outer harbor. Reports indicate that more than 50 vessels were wrecked on the Massachusetts coast, and as many more badly damaged and over 200 lives lost. The steamer *Portland* sailed Saturday evening after having been fully warned by the Weather Bureau, and was wrecked during the night or Sunday morning, and all on board, between 100 and 150 persons were lost. It is thought the steamer foundered at sea, owing to the fury of the storm, and only small portions of the boat with a number of bodies were found outside of Cape Cod.

New York, N. Y., E. H. Emery, observer:

Wind shifted to light easterly in the early morning, and gradually increased to gale velocity during the afternoon and night, and at midnight shifted to northwest, blowing at the rate of 54 miles an hour. Southeast storm signals were hoisted 11 a. m., and warnings of heavy snow for New York and New England, received from the Chief of

Weather Bureau, were distributed to all interests in this section. Snow fell during the afternoon and night to a depth of 6 inches, and drifted badly. 27th. Snow ended in the morning, a total depth of 9.7 inches having fallen. Northwest gale all day, with velocities ranging from 40 to 65 miles. All surface cars were obliged to suspend traffic, with the exception of one cable line in New York. Of the railroad lines centering in New York only two, the New York, New Haven and Hartford Railroad, and the Long Island Railroad were blocked. These are nearly parallel lines and were directly in the path of the storm. The tracks were covered, in places, with snow to a depth of 16 feet. Other lines were delayed, but owing to the timely warnings sent out by the Weather Bureau they were enabled to take precautionary measures whereby the delay in moving trains was minimized. Twenty ocean steamers were compelled to anchor in the upper bay, where they remained during Saturday night on account of the snow and gale. The fleet of sound steamers remained at the various docks about 20 hours waiting for the storm to abate.

The following are among many editorial comments made by the daily press regarding this storm, and the action of the Weather Bureau in forecasting its destructive character.

New York Times, December 1, 1898:

In leaving Boston Saturday night the captain of the *Portland* took chances which no man in his position had a right to take. From a source that warranted implicit belief, he, like every other captain on the Atlantic coast, had received warning that a storm of exceptional severity would strike him as soon as he reached open water, and he knew that his steamer, though well built and comparatively new, was of a type much better designed for entering shallow harbors than for encountering winter gales on as dangerous a coast as there is in the world. Despite all this, and, according to his employers, in defiance of implicit orders, he steamed out into the gathering tempest. Why? * * * Perhaps he belonged to the class, once large, but now small and rapidly disappearing, the members of which sneer at the Government Weather Bureau, and prefer to rely on old "signs" instead of on new science as the basis of meteorological prophesy. Perhaps, a score of things. Only this is certain, he should not have sailed, and he should not have been allowed to sail.

The Evening Star, Washington, D. C., November 30, 1898:

The full story of Saturday night's storm may never be told. Its deadly intensity is revealed by degrees in the wreckage which floats ashore, and perhaps in a few days some approximate estimate of the havoc then wrought on the New England coast may be approachable. Meanwhile it is clear that at least one great disaster marked the gale and that many lives were sacrificed. The steamer *Portland* went to pieces some time Saturday night or Sunday morning, so far out of her course as to show that the storm was of resistless strength and that it was the most criminal folly for the captain to put out from port. * * * At half past 10 on Saturday morning the Weather Bureau in this city wired to all its observers along the New England coast the following order:

"Hoist northeast storm signals; east to northeast gales, with heavy snow to-night."

The observers were also directed to warn all railroad and transportation interests of the coming of heavy snow throughout New England. The warning about the snow was particularly important. Often a ship can go to sea with comparative safety in the face of a storm if the air is not clouded, but when the snow is flying landmarks are obscured, lighthouses are useless, and the vessel is left to fate. * * * The *Portland's* captain ignored the official warning [which had been received some eight hours before sailing time], the gale then blowing, the heavy snow then falling, and the direct orders of his superior to keep in port. He carried with him to death over 100 people, who had no knowledge, presumably, of the desperate chances which he was taking. This tragedy serves to suggest that perhaps there may be some more positive method of preventing disasters in the face of solemn warning that danger is at hand. The traveling public ought to have some safeguard against this chance of death. A foolhardy commander should not be permitted to carry out to meet the hurricane his crew and passengers who rely upon his judgment. In many States the owners of ships which are put to sea in the face of the official danger warnings can not recover their insurance money. It may perhaps be possible for the States to go farther and take steps to actually prevent the sailing of vessels under such circumstances. However impracticable such a plan may appear at first glance, the circumstances of the *Portland's* wreck warrant the consideration of any suggestion tending to prevent repetitions of the tragedy.

Mr. William U. Swan, of the New England headquarters of the Associated Press at Boston, has submitted the following report in connection with this storm:

I was on Cape Cod on Tuesday after the storm and talked with many of the life-savers and others who were out in the blow, and they all seemed to agree that nothing so severe has ever been experienced in that part of the country.

The heft of the storm seems to have been about the time or shortly after the center passed over the Cape, which is generally agreed to have been about 9:30 on Sunday morning. The sky at that time over the stretch between Chatham and Barnstable cleared off entirely and the wind died out. Fifteen minutes after it was blowing hard from the north, and it was at this time that the gale wrought the greatest destruction among the trees from Yarmouth to Middleboro. In this respect Sandwich seems to have suffered the most, for not only did the silver oaks, as they are called, go down, but great elms in the town of Sandwich were blown across the streets, and it was a day or two before the main street was passable.

I could not find that the storm center was seen at Provincetown, or anywhere north of Eastham, but from the direction of the wind it seems probable that the storm took a diagonal course over the Cape.

THE LAKE STORM OF NOVEMBER 9-11, 1898.

The severe gale which visited the Great Lakes from the 9th to the 11th was the culmination of ten days or more of severe weather, which was very disastrous to lake marine interests. In referring to the work of the Weather Bureau during this period the Buffalo News of November 13, 1898, remarked editorially, as follows:

The Government Weather Bureau has again demonstrated in the view of all the people of the Lake region its great and growing importance as a factor in the commerce and travel of the inland seas. During the past ten days the Great Lakes have been swept by a continuation of severe storms, the fury of which but few vessels could withstand, although the majority of these vessels are as large, stanch, and seaworthy as any of the ocean liners; yet but comparatively few casualties occurred, which was due to the timely warnings of the Weather Bureau, and it is no exaggeration to say that in this instance alone millions of dollars worth of merchandise, hundreds of vessels, and probably many lives have been saved by the forecasts.

COLD WAVE WARNINGS.

The most important cold wave of the month overspread Montana during the 19th, extended over the upper Missouri Valley, with temperature below zero in Montana during the 20th, and carried the line of freezing weather, with snow and high northerly winds, as far south as Oklahoma during the 21st. By the morning of the 22d this cold wave had reached the western Lake region, the lower Ohio Valley, and the Middle and west Gulf States, with freezing weather as far south as San Antonio, Tex., and by the morning of the 23d it had reached the Allegheny Mountains, and freezing weather was noted as far south as Mobile, Ala. The morning of the 24th the minimum temperature at New Orleans and Mobile was 34° and 30°, respectively. On the latter part of the month continued cold over the eastern half of the country, and freezing temperature was reached along the south Atlantic coast on the morning of the 27th. Full and ample warning of the approach of abnormally low temperature, together with statements of the probable continuation of cold calculated to prove injurious to agricultural and commercial interests was telegraphed to all the districts visited except extreme northern Montana.

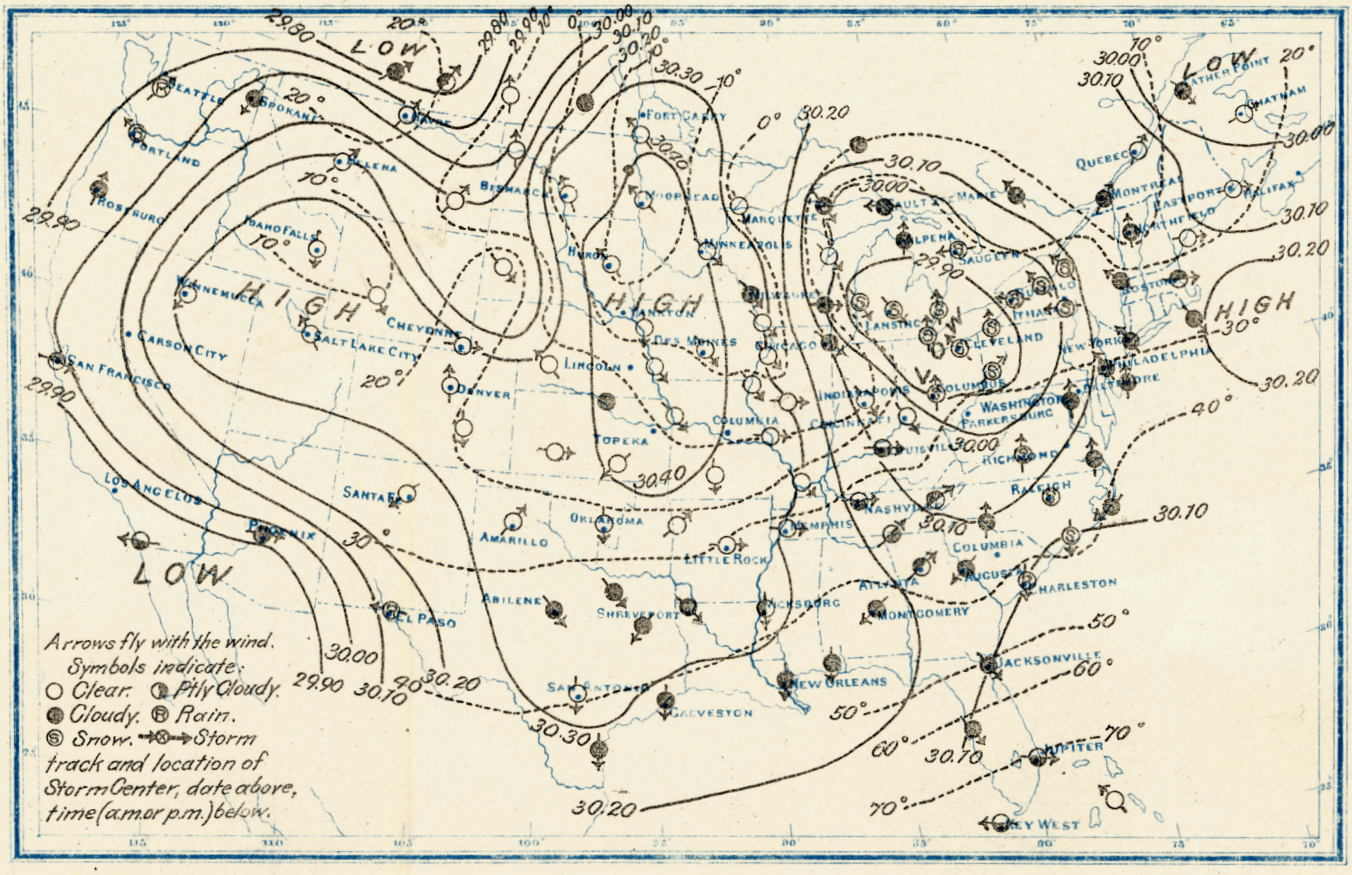
CHICAGO FORECAST DISTRICT.

The unusually stormy period in the upper Lake region continued over from October. The "northeaster" of the 9th and 10th was primarily due to the development of an area of high barometer of great magnitude over the Lake region. During the 9th a disturbance developed over the lower Mississippi Valley and moved in a northeasterly course, greatly increasing the force of the gale. Several vessels which had not heeded the warnings of the Weather Bureau were wrecked.

A severe "norther" and cold wave reached the eastern limits of the Chicago forecast district the evening of the 22d. Timely notice of its approach was given in the warnings issued

Chart X. Storm of November 26, 1898.

(a) 8 a. m.



(b) 12 noon.

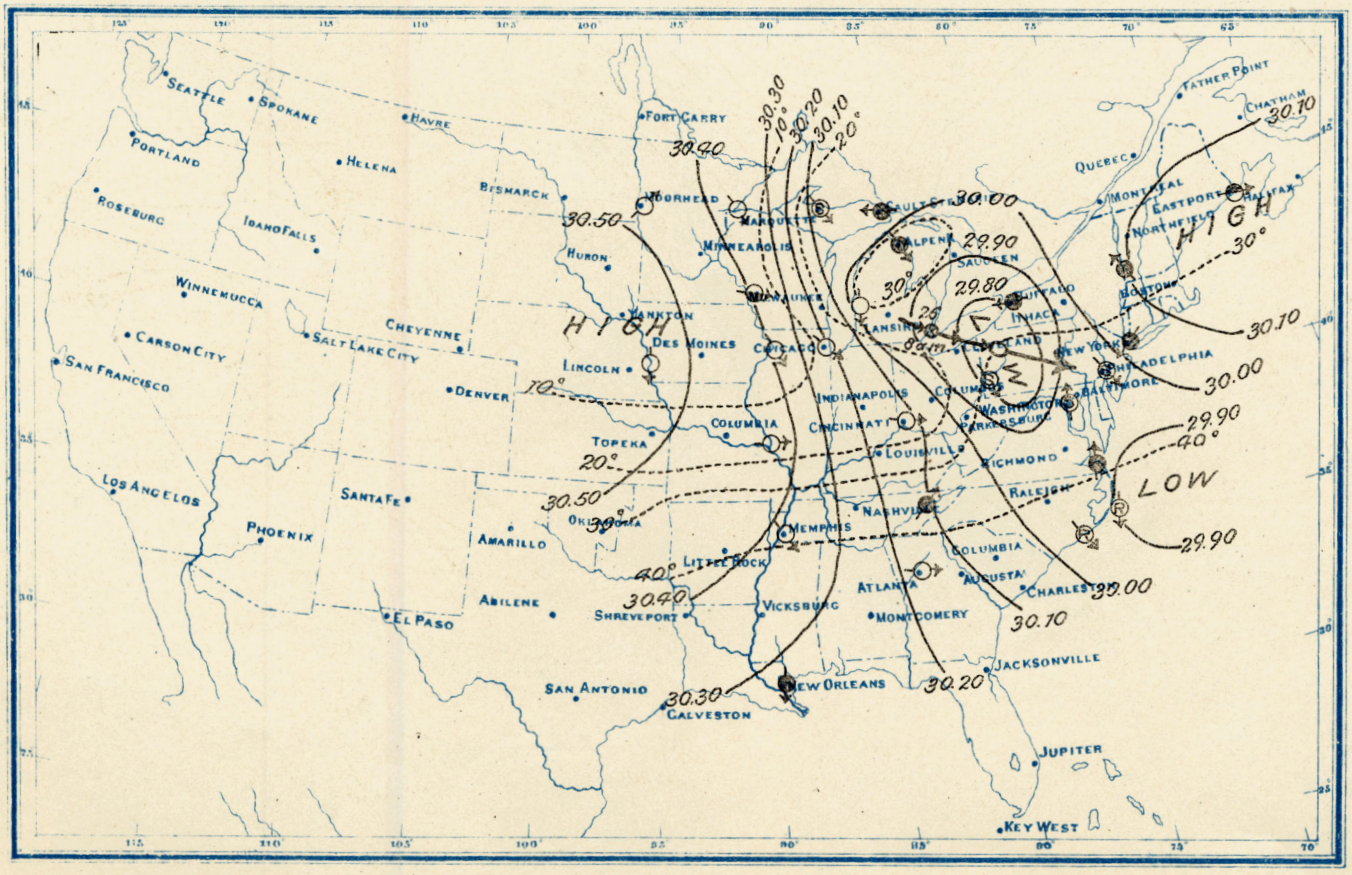
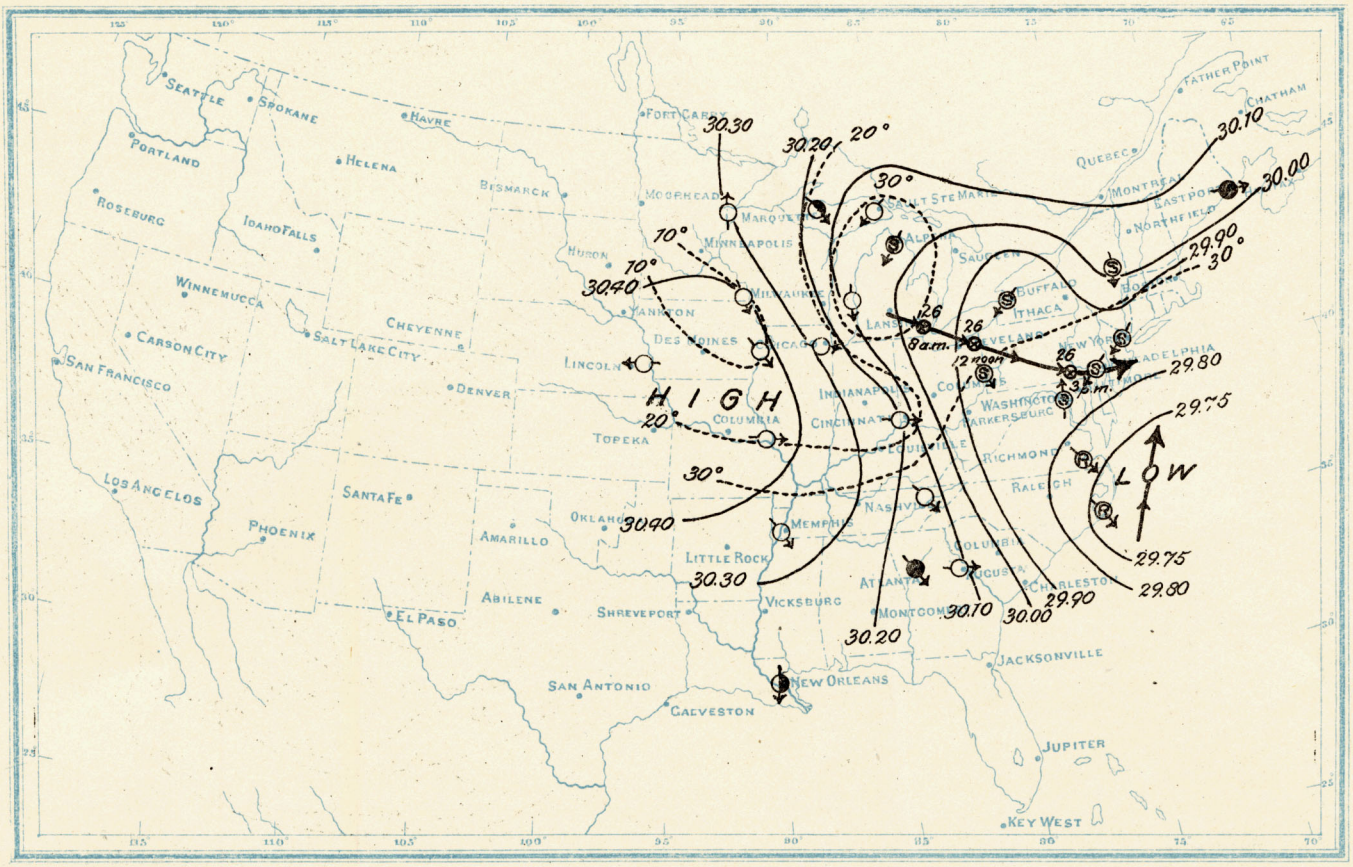


Chart XI. Storm of November 26, 1898.

(a) 3 p. m.



(b) 8 p. m.

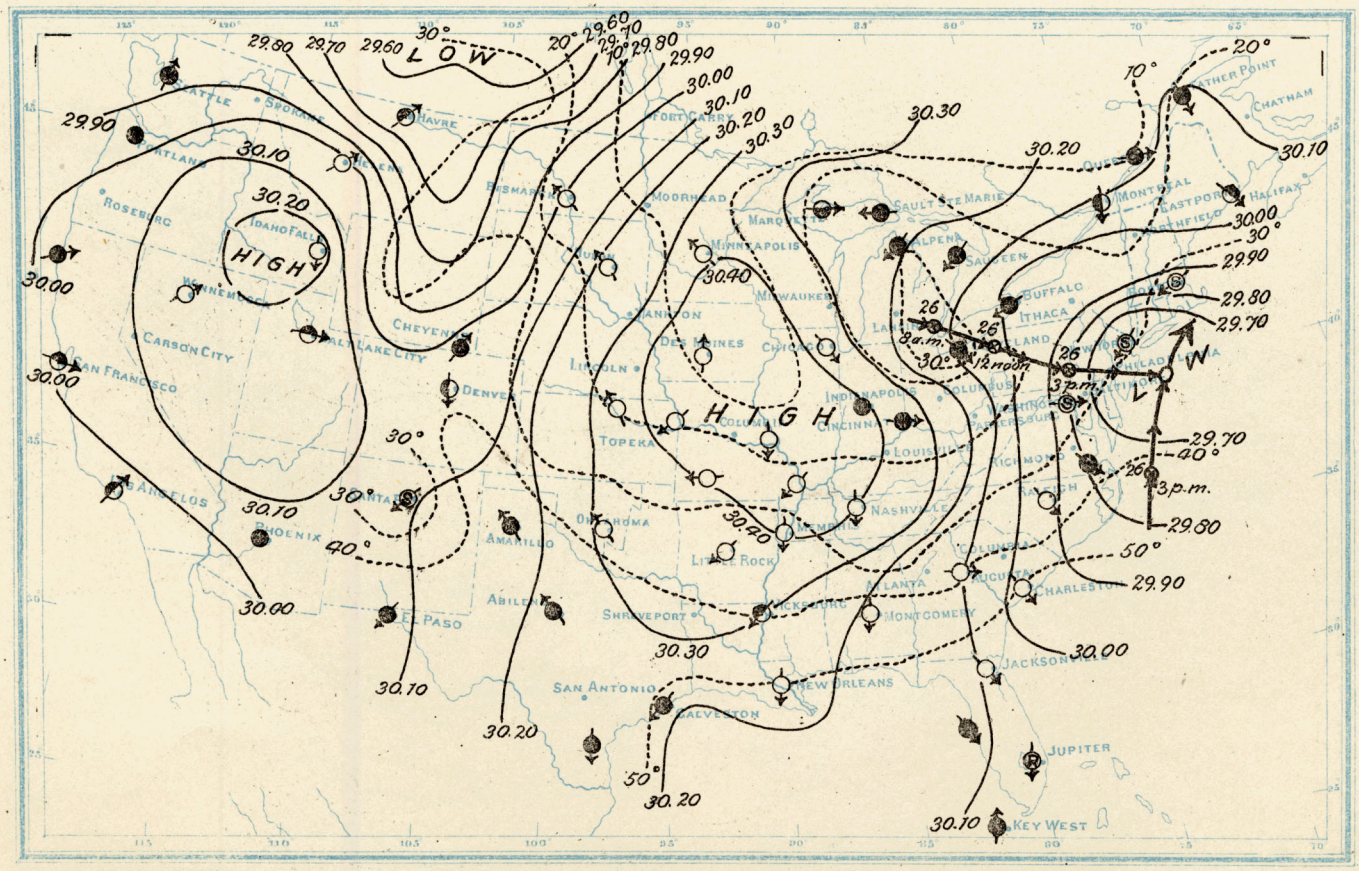
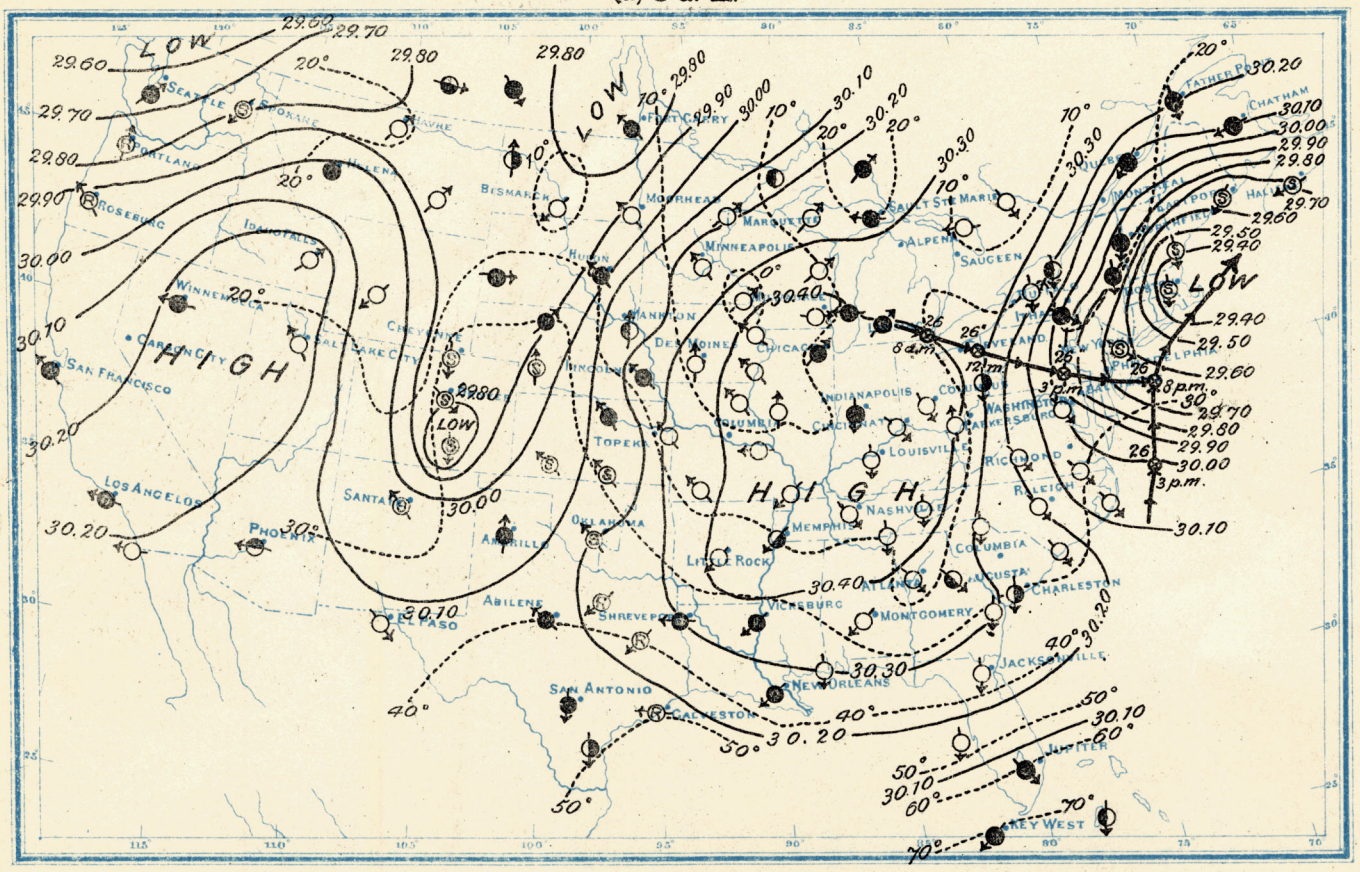


Chart XII. Storm of November 27, 1898.

(a) 8 a. m.



(b) 8 p. m.